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# ON THE TAXONOMY OF EROTYLIDAE (COLEOPTERA), WITH SPECIAL REFERENCE TO THE MORPHOLOGICAL CHARACTERS OF THE LARVAE

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(*Molteno Institute of Biology and Parasitology, Cambridge.*)

[Read 1st June, 1938.]

With Forty-Five Text-Figures.

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## Introduction.

It is, in theory, largely a matter of convenience at what genus one decides to divide one family from another, provided that some measure of conformity is observed in relation to the divergence of characters from the common type in each family. But the proviso is important, for as yet little is known of the genetics of beetles, so that one can only conjecture the value to be placed upon characters which may be found in them at one stage or another of their lives. Moreover, using such data as is available and without such knowledge, exceptions to this generalisation are sometimes found to occur, as has been the case in the course of the present investigation.

If the lead of Lewis (1884) were followed, as has been done by Arrow (1925) and many modern authors, the present family would be separated into two, Languriidae and Erotylidae, leaving the subfamily Dacninae with the latter. As will be seen later, this course would involve ignoring what appear to be important larval characters, which connect *Dacne* with the Languriinae and Cladoxeninae, though the corresponding characters in *Megalodacne* connect the genus with the Triplacinae and Erotylinae. These characters are firstly, the form of mandible, which in *Dacne* has a crushing mola and a flattened process in the incisory region between the mola and the apical teeth, whereas in *Megalodacne* the mandible is a scoop-like organ, without crushing mola and with a membranous process in the hollowed inner margin. Secondly,

the hypopharynx, which in *Dacne* has a highly developed corneous bridge between the two mandibles, in *Megalodacne* has the hypopharyngeal bridge reduced to a simple and narrow transverse bar.

One of the characters by which Verhoeff (1923) separated BRACHYPTERIDAE (*Meligethes*, *Brachypterus*, *Heterostomus*) from the NITIDULIDAE (*sensu stricto*) was the absence in the larvae of the former of epipharyngeal ridges (Querleisten), and Dr. Böving has kindly drawn my attention to the significance of these structures in the EROTYLIDAE. They are found beneath the clypeus in parallel rows, on either side of the epipharynx, in all CLADOXENINAE and LANGURIINAE, as well as in CRYPTOPHAGINAE and in *Dacne*. In *Megalodacne*, however, they are absent, as in all TRIPLACINAE and EROTYLINAE. It might be supposed that this character is directly correlated with the presence or absence of a grinding mola in the mandibles and a well-developed hypopharyngeal bridge, such as are found in the LANGURIINAE. But that this, at least, is not always the case may be seen by examination of the larva of *Byturus*, where the mola and the hypopharyngeal bridge are well developed but where there is a complete absence of the parallel epipharyngeal ridges.

Whether or not the presence of the epipharyngeal ridges is correlated with the form of the mandible and hypopharynx in EROTYLIDAE, this character cannot be used in the division of the family into two, without involving the separation of *Dacne* and *Megalodacne* in different families.

One further example of the intermediate position of the DACNINAE between the LANGURIINAE and TRIPLACINAE may be given. The maxillary lobe in the larva, both of *Dacne* and *Megalodacne*, is broad, somewhat obtuse and with a tendency to division at the anterior end, much as in the TRIPLACINAE, and is not falciform as in all LANGURIINAE and CLADOXENINAE (as well as in CRYPTOPHAGIDAE). This character appears to indicate affinity of both genera to the TRIPLACINAE, in spite of the tendency of other characters in *Dacne* towards the LANGURIINAE.

As regards the characters found in the adults, the closed anterior coxal cavities of both genera would associate DACNINAE with TRIPLACINAE and EROTYLINAE, but the acuminate or abbreviated terminal segment of the maxillary palp would bring them into the LANGURIIDAE rather than the EROTYLIDAE (*sensu restricto*), where the terminal segment is curiously widened and transverse, frequently in triangular or semilunar form. The clearly visible, though short fourth tarsal segment in adult DACNINAE is not typical of any of the other four subfamilies named, but seems rather to be related to the simple, pentamerous form of tarsi found in *Pharaxonotha* among the CLADOXENINAE as here arranged, and even of the CRYPTOPHAGIDAE, which I have treated as a separate family.

It is evident, then, that the relationship of the DACNINAE with the TRIPLACINAE on the one hand, and with the CLADOXENINAE and LANGURIINAE on the other, is so close that the division of the family into two, LANGURIIDAE and EROTYLIDAE, would separate the larva of *Dacne* (in the family LANGURIIDAE) from the larva of *Megalodacne* (in the EROTYLIDAE); while the adults of both, on the basis of the closed anterior coxal cavities, would be associated with the EROTYLIDAE, but on the basis of the pointed maxillary palp, with the LANGURIIDAE.

On the other hand, with the facts available, the proposal of Böving and Craighead (1931) to separate the DACNINAE, with certain genera usually referred to the MELANDRYIDAE, into a separate family could only be justified by the assumption that a family may be constituted of a number of genera bearing

certain characters in common which are also borne by one or other of the families adjoining it. Such an assumption would reduce the rank of the family to a meaningless abstraction. As a subfamily, however, it is possible, and indeed necessary, to regard the DACNINAE. To separate *Dacne* and *Megalodacne*, placing *Dacne* with the LANGURIINAE and *Megalodacne* with the TRIPLACINAE, would be to divide into separate subfamilies two genera which, on the adult characters, were formerly regarded as one. As a subfamily it forms an intermediate link between the LANGURIINAE and TRIPLACINAE, partaking of some characters of each.

Examples of the intermediate condition in the DACNINAE have just been given. An example of the grading of one subfamily into another, in another part of this family, may now be taken. In the larvae of EROTYLINAE the spiracles have been considered, and indeed without close examination appear, as annular, though in all other subfamilies of EROTYLIDAE each has two accessory chambers in addition to the annular opening. In the larva of *Cypherotylus goryi*, however, it has been found that, though functionally the spiracles are uniforous, there are processes on one side of the opening of each which can only be interpreted as two undeveloped chambers. Whether these processes might have developed into chambers under different conditions, or whether they are genetic survivals from an ancestry which had bicameral spiracles cannot, of course, be judged from existing material. But whichever interpretation is true, they provide a useful link between the annular spiracle of the larvae of EROTYLINAE and the annular-bicameral spiracle of those of TRIPLACINAE.

It appears, therefore, that in the composition of the family one must revert almost, if not entirely, to the classification of Ganglbauer (1899). But there remains the difficulty of the position of the CRYPTOPHAGINAE and ATOMARIINAE, included by him within the EROTYLIDAE as subfamilies.

The separation of the ATOMARIINAE, either in adult or larval stage (Newton, 1932), presents no great obstacle, though there are evidently points of resemblance in the latter to the CRYTOPHAGINAE.

The position of the CRYTOPHAGINAE is less easy to determine. As will be seen by reference to the heading CLADOXENINAE, the differences between that subfamily and the CRYPTOPHAGINAE are apparent in a comparatively few characters, either in adults or larvae. Evidently they are rather nearly related and the question again arises as to whether these two subfamilies should be regarded as belonging to the same or to different families. If they were regarded as belonging to the same family, the further difficulty would arise of placing certain other families, such as MONOTOMIDAE, BYTURIDAE and ANTHICIDAE, which, at least in the larval stages, bear considerable resemblance of characters to one or more subfamilies of the enlarged family. It seems necessary, therefore, to apply the principle referred to at the beginning of this introduction and, while retaining in the family EROTYLIDAE those genera which show the closest similarity of characters, to divide the family from the CRYPTOPHAGIDAE, which, though showing some characters possessed by their nearest relatives of the EROTYLIDAE, yet admit other characters not possessed by those near relatives. Thus *Pharaxonotha* and *Hapalips* are both frequently referred to the family CRYPTOPHAGIDAE, but reasons are given when dealing with these two genera for referring them to the CLADOXENINAE, as a subfamily of EROTYLIDAE.

Doubtless the opposite course could be taken reasonably and a number of related families included in one. The disadvantages of this course would be

its large size and the extended relationship of the genera comprised in it. The term family would be almost, if not quite, comparable with some super-families and the conception of its meaning would need to be changed.

Excluding, then, the CRYPTOPHAGINAE and ATOMARIINAE as belonging to the separate family of CRYPTOPHAGIDAE, the classification of Ganglbauer is substantially followed here. The subfamilies recognised are CLADOXENINAE, LANGURIINAE, DACNINAE, TRIPLACINAE, EROTYLINAE, the three last-named corresponding to the similarly named tribes of Ganglbauer, and the Xenoscelini and Diphyllini being omitted.

There is considerable diversity in the larval characters of this large family and consequently it is difficult to give a diagnostic summary of the whole. The following represents an attempt:

Head capsule open behind (*cranium apertum* of Verhoeff, 1923); clypeus articulated with labrum; antenna three-segmented, with ventral accessory segment at apex of second segment; ocelli usually 5–6, in a group behind the antenna, with one, or sometimes two, placed more ventrally (fewer in LANGURIINAE); labial palps two-segmented; maxillary mala entire, though sometimes with anterior fissure, and with one to three inwardly directed unci at apex; cardo usually long and forming an elbow of 90° or less with stipes (except in some TRIPLACINAE and EROTYLINAE); maxillo-labial complex with superficial articulating area (except in TRIPLACINAE and some EROTYLINAE); mandible either with mola, or else without and with an inner membranous process; spiracles annular-bicameral, except in EROTYLINAE; terminal pseudocerci present on 9th abdominal segment; anal pseudopod bilobed.

An analytical key will be given in the concluding part of this paper. The difficulty of adapting a dichotomous key to the position when intermediate characters between two groups occur is well shown in the following key.

### KEY TO LARVAL CHARACTERS OF SUBFAMILIES.

A. 1. Mandible with mola, with hyaline process between mola and apical teeth and with single cutting edge; maxillary mala, falciform, with row of setae on inner margin dorsally; hypopharynx with anterior horns; epipharynx bearing a row of oblique ridges on either side; ligula scarcely produced . . . . . 2.

Mandible without mola or hyaline process, but scoop-shaped and with fleshy process on inner margin; maxillary mala obtuse, without row of setae on inner margin; hypopharynx without anterior horns; epipharynx without ridges; ligula produced anteriorly . . . . 3.

2. Mandible usually with hyaline process pointed and tooth-like (absent in *Teretilanguria*); ocelli less than five on each side . . . LANGURIINAE.

Mandible with hyaline process laminous except in *Hapalips*; ocelli five to six on each side . . . . . CLADOXENINAE.

3. Head with or without articulating sclerite between labium and maxilla; antennae long, especially the second segment of each, accessory segment reduced to a tubercle; frequently with 2 long filamentous caudal processes; spiracles annular . . . . . EROTYLINAE.

Head without articulating sclerite between labium and maxilla; antennae rather short, accessory segment longer; caudal processes hook-like or rather short; spiracles annular-bicameral . . . . . TRIPLACINAE.

B. Mandible and hypopharynx of the same type as either section of A 1., maxillary mola broad or obtuse, with row of setae along inner margin; ligula not produced . . . . . DACNINAE 4.

4. Mandible with mola and single cutting edge, with hyaline process between mola and apical teeth; hypopharynx with anterior horns; epipharynx with oblique ridges . . . . . *Dacne.*
Mandible without mola or hyaline process, scoop-shaped; hypopharynx without anterior horns; epipharynx without ridges . . . *Megalodacne.*

## The Labium of the Larva.

Some confusion has arisen regarding the identity of the sclerites of the labium in larvae and adults, both of Coleoptera and other biting insects. In order to resolve this Snodgrass (1935) and Anderson (1936) have investigated the position of the labial muscles, holding that the insertions of these muscles are the surest guides to the identity of the sclerites to which they are attached. Anderson's paper is devoted to a study of the labium in Coleopterous larvae, and he found that, using as a test the insertion of the labial retractor muscles at the base of the prementum (or terminal segment of the labium), in most larvae the prementum has become secondarily divided into two, so that the middle portion, usually considered as the mentum, is in reality a second division of the prementum. The posterior portion of the labium, the postmentum, represents the mentum and submentum of the adult and is composed of the plate or plates posterior to the insertion of the retractor muscles on the prementum and to the superficial suture usually to be found in the immediate neighbourhood of this insertion. Anderson gives descriptions and figures of the condition found in *Languria* and *Tritoma,* and I am able to confirm his observations of the insertion of muscles at the base of the second prementum in other genera of Languriinae and Triplacinae and also in *Dacne.* In *Pharaxonotha* and in the Erotylinae I have not yet found muscles in a corresponding position, but in view of the difficulty of identifying a pair of small muscles in material long preserved, it seems probable that these also follow the general rule of the family.

Difficulties in the identification of the labial muscles, however, continue to arise, owing to the shifting of their position in the course of evolution. Thus in two genera of the Languriinae, for example, three pairs of muscles are found attached to the first prementum, one pair clearly inserted medianly at the base, the other two, the dorsal and ventral adductors of the labium, laterally. It is tempting to regard these median muscles, which arise at the base of the labium, as its true retractor muscles and thus to identify the terminal part of the labium as the sole prementum, the remainder as composed of the mentum and submentum. Careful examination, however, has revealed a further pair of muscles overlying the first, arising near the base, extending forwards for only a short distance (see fig. 35) and inserted at a point considerably posterior to the membranous connection of labium with maxillae. If these muscles are to be regarded as the original retractor muscles of the labium, as Anderson has done, those inserted on the first prementum must be considered as of secondary development in their present position, even though their function appears to correspond to that of the retractor muscles in the cockroach.

Since the substance of what has been written above was committed to paper, Dr. O. W. Richards has most kindly drawn my attention to a further important paper on the musculature of the mouth-parts of insect larvae, by G. M. Das (1937, *Quart. J. micr. Sci.* **80** : 39–80). Das has examined the labial muscles in the larvae of a considerable number of orders and found that there has been some shifting in the point of origin of some of these muscles. He considers that (i) the prementum may be identified by being the origin of the

muscles of the palps and lobes of the labium and by the insertion of the prementa muscles on its proximal border; (ii) the mental plate, when present, lies prominal to the insertion of these prementa muscles and distal to the insertion of the submento-mental muscles; and (iii) the submental plate may be identified as the origin of the submento-mental muscles and some of the prementa muscles. He believes that Snodgrass has failed to distinguish between the median muscles of the prementum and the submento-mental muscles in many larval Coleoptera, and that Snodgrass's view that the median muscles are the only muscles having their origin on the postmentum is not always correct. He regards the mentum as the representative of the united cardines, the submentum as that of the sternum of the labium.

There is thus considerable divergence of opinion regarding the identity of the parts of the labium and particularly of the identity of the two important pairs of median muscles. The interpretation of Das, however, seems better to fit the condition found in Erotylid larvae and particularly that of the two genera of Languriinae (*Caenolanguria* and *Teretilanguria*) referred to above. His terminology is therefore adopted here, though it is recognised that further work on this subject, and particularly that on the later stages of the insects, may throw fresh light upon it.

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Further, I should like to express my thanks to Herr F. Nevermann, of Costa Rica, who has collected and preserved so many of the central American coleopterous larvae. Those used in this work have reached me through the good offices of Dr. van Emden.

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## Cladoxeninae Arrow.

Until 1925 the genera of which this subfamily is composed were included either amongst the Cryptophaginae or the Languriinae. In that year Arrow published his volume on the Erotylidae in the *Fauna of India* series and separated the Cladoxeninae as a distinct subfamily of Languriidae. Later (1929) he considered that *Pharaxonotha* should, as of old, remain within the Cryptophagidae. This question is further considered later.

The genera included by Schenkling (1928) under this subfamily are as follows: *Pharaxonotha*, *Microlanguria*, *Paracladoxena*, *Cladoxena*, *Thallisellodes* (now regarded by Arrow as synonymous with *Platycladoxena*), *Thallisella* and *Crotchia*.

The adult characters (largely as given by Arrow, though, the selection being mine, no responsibility must be assigned to him) are these:

Anterior coxal cavities open behind. Terminal segment of maxillary palp bluntly pointed. Fourth tarsal segment hidden in third segment (except in *Pharaxonotha* where it is minute, but free). First three tarsal segments usually lobed transversely, but simple in *Pharaxonotha*. Inner lobe of maxilla ending in one or more sharp spines or hooks. Antenna terminating in a symmetrical club of three segments.

These may be compared with the adult characters of CRYPTOPHAGINAE:

Anterior coxal cavities open behind. Terminal segment of maxillary palp more or less pointed. Tarsi (except in Telmatophilini) without lobes. Fourth tarsal segment not hidden, though tarsi are sometimes heteromerous. Inner lobe of maxilla terminating in a hook, sometimes bipartite. Antenna with club of three, sometimes two, segments.

As will be observed, the adult characters of the two subfamilies are much alike.

The larval characters of CRYPTOPHAGINAE, so far as they are known to me, are these:

Labial palps single-jointed; anal pseudopod not bilobed (except in *Antherophagus*); head without metopic (coronal) branch to epicranial suture; ocelli less than five; labrum incompletely separated from clypeus; mandible with mola, and with slender pointed process anterior to it projecting inwardly, apical teeth two; articulating sclerite present between maxilla and labium on either side; maxillary mala falciform, with a row of setae along inner margin; hypopharynx with anterior submedian horns; setae of body sometimes modified; terminal pseudocerci usually, but not always, present (*see* Perris 1877; Falcoz 1922, 1924; Verhoeff 1923; van Emden 1928).

The larval characters found in CLADOXENINAE are:

Labial palps biarticulate; anal pseudopod bilobed; head without metopic branch to epicranial suture; ocelli five on either side, usually four in a square and one ventrally; labrum completely separated from clypeus; mandible with mola and hyaline process (pointed in *Hapalips*), apical teeth two; articulating sclerite present; maxillary mala falciform and with row of setae along inner margin; hypopharynx with anterior horns; dorsal setae of head and body modified (? always); terminal pseudocerci present.

In the larval state, then, the CLADOXENINAE differ from the CRYPTOPHAGINAE chiefly in having the labial palps biarticulate, so large a number as five ocelli on either side, the labrum completely separated from the clypeus and at least sometimes, in having the hyaline process of the mandible flattened, dorsi-ventrally, instead of being pointed as in the CRYPTOPHAGINAE and, to less extent, the LANGURIINAE. The presence of two papillae, side by side, at the apex of the anal pseudopod—a character which appears to be constant in the EROTYLIDAE, though not confined to them—is found also in the larva of *Antherophagus*. It is not found in *Cryptophagus*, nor so far as I know in other CRYPTOPHAGINAE. Pointed pseudocerci, present in the CLADOXENINAE, are usually present in the CRYPTOPHAGINAE, but may be lacking in the group Telmatophilini.

Arrow (1929 : 313) considered that *Pharaxonotha* must be referred to the

CRYPTOPHAGIDAE on account of the simple pentamerous tarsi of the adult. This character is striking when compared with the dilated tarsi of the LANGURIINAE, which have the fourth segment, though present, hidden between the adjoining segments.

In the larva, however, the characters resemble those of *Platycladoxena* and *Hapalips* rather than those of the CRYPTOPHAGIDAE. First of these should be named the biarticulate labial palps and the bilobed anal pseudopod, both characteristic of the EROTYLIDAE, though the latter is also borne by *Antherophagus* among the CRYPTOPHAGIDAE. In addition, (i) the pattern of the five ocelli is a type frequently found in the EROTYLIDAE, notably in *Platycladoxena* and *Dacne*; (ii) the flattened translucent mandibular retinaculum is also found in *Platycladoxena* and *Dacne*; and (iii) the two lines of lateral tubercles along the body appear to connect this genus with *Platycladoxena* and *Hapalips*.

On the other hand, it is to be observed that the arrangement of the 10th abdominal segment, in which the tergum and sternum form the base of the anal pseudopod in *Pharaxonotha*, is also found in the CRYPTOPHAGIDAE, whereas in *Hapalips* and *Platycladoxena* the arrangement resembles that in the LANGURIINAE. In these the tergum of the 10th segment lies posterior to the anal pseudopod, and the sternum alone forms its base, so that on retraction the pseudopod can be enclosed within the tergum and sternum, as by the flaps of a valve. This character appears to be one of importance and, to my knowledge, does not occur in the EROTYLIDAE outside the subfamilies CLADOXENINAE and LANGURIINAE. The character of tergum and sternum forming the base of the anal pseudopod is, however, found in *Dacne* and other Erotylids as well as in the CRYPTOPHAGIDAE.

If the CRYPTOPHAGIDAE are indeed a primitive Clavicorn group, giving rise to various other groups, including the EROTYLIDAE, as Arrow suggests (1919 : 305), it seems permissible to suppose that *Pharaxonotha* is an intermediate species, bearing characters appertaining both to the ancestral CRYPTOPHAGIDAE and to the more recent family EROTYLIDAE. Therefore, though Arrow's opinion that it should be included with the CRYPTOPHAGIDAE may well be correct, the larval characters mentioned above seem to be sufficient to include it with the EROTYLIDAE and among the CLADOXENINAE.

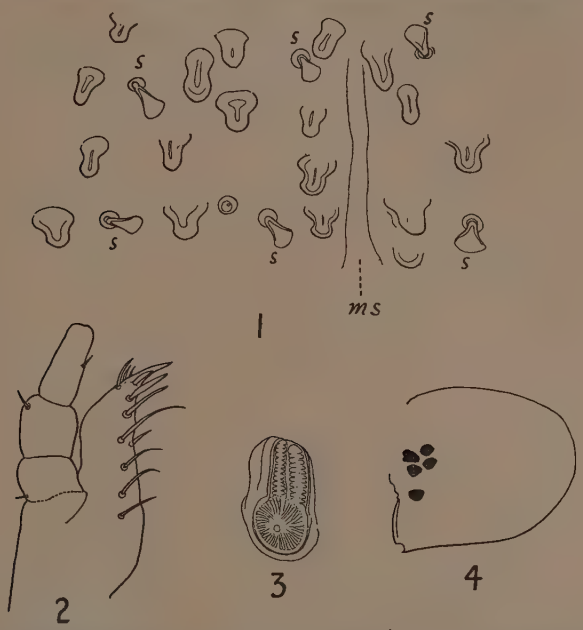
It may be noted that the tarsi of *Pharaxonotha* in the adult stage, though they lack the dilatation found in the other genera included in this subfamily, yet bear a resemblance to *Dacne* in this respect, as also in the fact that all five segments are free.

*Pharaxonotha zamiae* Blake.

Four larvae received from the United States National Museum per Dr. A. G. Böving; taken from ♂ flowers of *Zamia*, near Homestead, Florida, 28.xi.1919, by Schwarz and Barber. One specimen was mounted, the remainder were in spirit.

Length (in spirit) about 4·5 mm., breadth of widest segment (3rd abdominal) about 9 mm. Hardly fusiform, but a little narrowed in front and behind. General colour yellow with a broad brown transverse bar across each segment, interrupted by a narrow median suture. Lateral and ventral surfaces yellowish-white. Most setae slightly capitate. Pseudocerci extended posteriorly. *Head* horizontal, epignathous, exserted, broader than long, rounded at the sides, brown above and paler beneath. Epicranial suture lyre-shaped, without metopic branch. *Labrum* transverse, rounded in front and bearing eight inward-bending setae along the margin on each side. The dorsal surface also bears four longer tapered setae. *Clypeus* completely fused with frons, but articulated with labrum. It

bears a row of four transverse setae. *Epipharynx* with a median V-shaped hairy process anteriorly and with a row of transverse chitinous bars on either side. *Ocelli* five on either side, of which a group of four is placed in a square close to the antenna and one a little more ventral (fig. 4). All have convex lenses. *Antenna* rather short, on a raised conical base. The first segment about twice as broad as long, the second the longest segment and the third a little shorter than the second. Accessory segment placed ventrally at apex of the second; short, pointed and articulated. *Mandible* with two teeth at the apex, a distinct and prominent mola, marked with transverse striae, and a flattened, triangular, translucent process in the excavated space between apex and mola. A small, round, membranous lobe, bearing fine, short hairs is placed on the inner margin, at the base of the mola.




FIGS. 1–4.—*Pharaxonotha zamiae.* 1. Portion of tergum, 1st abdominal segment, to show modified setae (*s*) of median and posterior areas, × 350 cir.; *ms.* medio-dorsal suture. 2. Apex of maxillary mala, dorsal surface, × 200 cir. 3. Thoracic spiracle, × 350 cir. 4. Arrangement of ocelli, × 85 cir.

*Maxillary mala* (fig. 2) pointed and turned inwards at the apex, where there are three curved spinous processes or unci pointing inwards. A single short seta is borne on the inner margin and a group of three short setae anteriorly just behind the apex. A row of rather long curved setae close to the inner margin projects beyond it on the dorsal surface. *Stipes* slender. *Cardo* forming a sharp angle with the stipes, long, narrow and pointed. *Maxillary* palp three-segmented, extending considerably beyond the mala. Between the maxilla and the labium on either side there is a more or less triangular *articulating area*, which is almost membranous.

*Labium* free for almost half its length, widely separated from the maxilla on either side. *Prementum* a little broader than long, rounded in front and without developed ligula. *Labial palps* biarticulate, palpiger weak. *Mentum* long, broadest in the middle, reaching nearly to the level of articulation of the maxillary cardines. *Submentum* short, broadest

at base and narrowed gradually to anterior margin, bearing a pair of short tapered setae. *Gula* membranous, short but broad. *The ventral bay*, which serves for the reception of the inferior mouth-parts, is wide and long. The hypostomal ridge is continued beyond the angle of the bay for a considerable distance, inclining outwards on either side. *Hypopharynx* with two submedian horns, overlaid on either side by a densely hairy process attached to the membrane lining the dorsal surface. A further tuft of hairs inclined backwards lies between them. Strong lateral ligaments or "bracons" connect the hypopharynx with the base of the mandible on either side. Arising at the base of these the fleshy lingua or ventral pad extends beneath the labium to its anterior margin, bearing a pair of flange-like, slightly hairy superlinguae. A pair of suspensory apodemes supports the hypopharynx, posteriorly and dorsally, one on either side of the pharynx.

*Body*. The pronotal plate is yellow-brown, longer and smoother than any other tergal plate. It is bordered in front by four or five and at each side by eight capitate setae. In addition to the major setae there is a row of six minute setae, each modified to the form of a battledore, along the posterior margin, as well as some six or eight similar setae, scattered in pairs over the central area. Medianly the plate is interrupted by a pale and narrow suture. The other *tergites* from the mesothorax to the 8th abdominal segment are without setae on the anterior margin, but bear two rows of major capitate setae laterally on either side. These consist of five setae in the two thoracic, four in the abdominal segments, in the more lateral row; and two, a longer posterior and a shorter anterior seta, in the more dorsal row, all arising from tubercles. The surface of each tergal plate bears numerous minor callosities, which when magnified resemble immature mushrooms (*Agaricus*), and also two transverse rows of six modified minor setae in each, one a little anterior to the middle, the other posteriorly amongst the longer cuticular callosities of the surface (fig. 1). The anterior and posterior margins of each tergite are pale and without sculpture. The *pleuron* is pale and bears two or three short, slightly capitate, setae. Pleural suture obscure in the abdomen. The *sternum* is also pale in colour and bears two sparse transverse rows of fine setae. The *9th abdominal tergite*, seen from above, is semicircular and bears a pair of pointed pseudocerci posteriorly, with a rounded space between them. The surface is coarsely granulate, like that of the preceding segments, and hollowed in the middle. The pseudocerci are only a little upturned and bear two or three setae on the surface of each. In addition to the pseudocerci the tergite bears some five horny warts on either side, of which one lies on either side of the middle and the remainder laterally. These warts appear to represent the setiferous papillae on the preceding segments, which gradually increase in size towards the posterior end of the larva. The two submedian ones are the largest, are bifurcate at the apex, and somewhat curved backwards. The pleurite forms an arch surrounding the 9th sternite and the 10th segment. The sternite adjoins that of the 8th segment and is excavate posteriorly, enclosing the anterior part of the 10th. The *10th abdominal segment* is ventral, a little posterior to the middle of the 9th segment. It forms the base of the short tube from which the pseudopod is extended, but is not valve-like, as in the Languriinae. The pseudopod itself consists of two round lobes, side by side.

*Legs* rather short, placed not very close together and bearing a moderate number of short tapered setae. Coxa short and sub-oval; femur about equal in length to coxa; tibia shorter; claw short and bent, with two short setae at its base.

*Spiracles* extremely small, situated laterally in the anterior part of the mesothorax (fig. 3) and in the anterior part of each abdominal tergite. Each is slightly raised above the surrounding surface and is composed of a rounded atrium bearing a minute circular opening in the centre and two chambers lined with a row of spines on either side. The atrium bears a large number of hairs, or unbranched trabeculae, directed towards the middle of the lumen. The chambers are almost closed above by the spines but are open at the apex of each.

Note. *Pharaxonotha kirschi* Reitt. bears a close resemblance in the larval stage to *P. zamiae*. The figures of the former given by Böving and Craighead (1931) illustrate in general the present species, so that only a few figures of *P. zamiae* are given here. The larva of *P. kirschi* is considerably larger than that of *P. zamiae* and bears callosities on the tergal plates of a less definite form. It is found in stored grain and other foodstuffs, and with them has been distributed both in the United States and Europe. The species has, it is believed, been introduced from Mexico (Chittenden, 1911; Zacher, 1926).

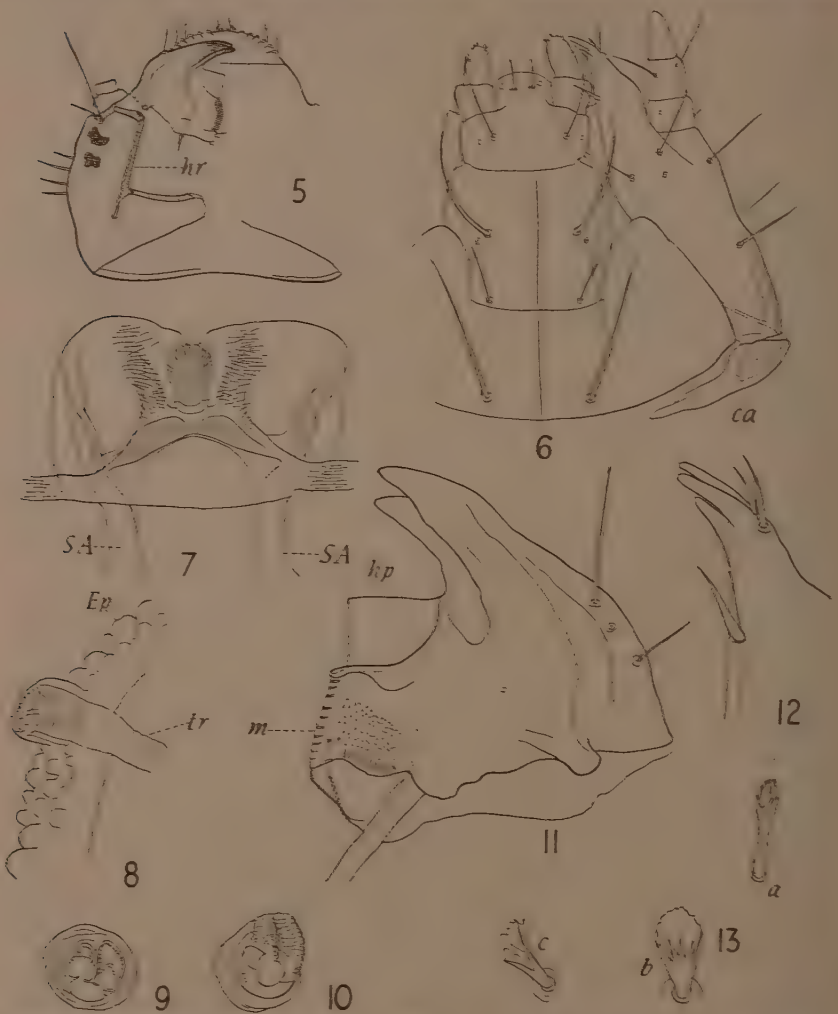
*Platycladoxena angulosa* Arrow.

A brief general description of the larva has already been made by Dr. K. G. Blair (1929). I am indebted to him for the opportunity of examining five specimens found by Mr. C. Dover with adults in Dark Cave, Batu Caves, Selangor. They occurred on a lichen-covered rock, 400 feet from the entrance. Though the larvae were not bred to maturity, it is almost certain that they belong to this species on account of their association with adults, added to their evident Cladoxenine characters.

Length (in spirit) about 5 mm., breadth of metathorax a little less than 1 mm. Hardly fusiform, but narrowed a little in front and behind. White, with yellowish-brown head. Some of the dorsal setae are short and scale-like, but laterally there are two longitudinal rows of long setae borne on projecting processes or tubercles on either side. The 9th abdominal segment bears a pair of recurved terminal pseudocerci and anterior to them a pair of upturned hooks curving backwards. *Head* exserted, almost epignathous, rather flat, transverse, rounded at the sides. Brown granulations are borne on the dorsal surface, forming a symmetrical pattern on either side of the median line. Cranial sutures obsolete. Setae short and scale-like on the dorsal surface, longer at the sides. Of the modified setae four form a transverse row at the base of the head (fig. 13, a), two are placed submedianly on the undifferentiated frons and a longer pair, one on either side of the frons, laterally. *Ocelli* six on either side, black; consisting of four almost in a square posterior to the antenna, one large and one small ocellus ventrally, near the articulation of the mandible. *Clypeus* completely fused with epistoma-frons. *Labrum* distinctly separated from clypeus, with a row of some sixteen incurved setae on the anterior margin and with four setae dorsally on each side. *Epipharynx* with a median V-shaped process of short hairs and a series of about fifteen oblique ridges on either side beneath the clypeus. *Antenna* short, on a large conical fleshy base. Basal segment short, the 2nd longest and 3rd nearly as long as the 2nd. Accessory segment, placed ventrally at apex of the second, is considerably narrower and about two-thirds of the length of the third segment. *Mandible* (fig. 11) nearly triangular, with two subequal teeth at the apex. At the base is a mola, which is distinctly cuspidate on the inner surface, has numerous straight parallel striae dorsally and transverse rows of granulations ventrally. The hollowed space between mola and apical teeth is occupied by a thin and translucent rectangular process, slightly thickened on its anterior margin. At the base of the mola there is a small membranous lobe on the dorsal surface, projecting inwards and bearing a fringe of minute hairs on its inner margin. *Maxillary mala* (figs. 6 and 12) gradually narrowed and turned inwards to the apex, where there are three unci projecting in the same direction. At the base of the unci on the anterior or outer margin there is a slightly raised tubercle bearing three short, tapered setae; and on the inner margin slightly posterior to the unci a single seta. Dorsally the inner margin bears a long row of tapered setae. The structure of the mala bears a close resemblance to that of *Pharaxonotha*, as well as to those of the CRYPTOPHAGINAE. *Cardo* long, widened in the region of its articulation with stipes and thence narrowed gradually to a point, at which it articulates with the hypostomal ridge (fig. 5, *hr.*). It is inclined at an angle of some 90° to the plane of the

stipes. In this angle between the stipes, the cardo and the labium a corneous subtriangular ***articulating area*** is developed.

*Labium* (fig. 6) free almost to base of the mentum. *Prementum* broader than long bearing two biarticulate palps and two long setae. The ligula is broadly rounded in front




FIGS. 5–13.—*Platyladorena angulosa*. 5. Head, ventral surface, × 45: *hr*. hypostomal ridge. 6. Inferior mouth-parts, × 145: *ca*. cardo. 7. Hypopharyngeal bridge, ventral aspect, × 220: *SA*. suspensory apodemes. 8. Seventh abdominal spiracle in profile, × 350: *tr*. trachea. 9. First abdominal spiracle, × 490. 10. Thoracic spiracle, × 350. 11. Mandible, ventral surface, × 220: *hp*. hyaline process; *m*. mola. 12. Apex of maxillary mala, ventral surface, × 350. 13. Modified setae, × 350, (a) from posterior row on head, (b) sub-median on 5th abdominal segment, (c) from anterior row of 2nd abdominal segment.

and scarcely produced. *Mentum* longer than either of the other parts of the labium. It bears two pairs of tapering setae, the first (and longer) near the middle, the second near the posterior margin. *Submentum* broader than long, its lateral margins scarcely separated from the adjoining articulating sclerites. It bears a pair of long setae at its base. A fine median suture extends from the base of the submentum to the anterior margin of the mentum. At the base of the submentum, between the two posterior tentorial pits, lies the *gula*. It is closely united to the submentum, semi-membranous, short and transverse.

The *ventral bay* (fig. 5) is rectangular and twice as wide as long. The hypostomal ridge is continued a little way beyond the angle on each side towards the base of the head. The occipital foramen is widely open and reaches to within a short distance of the ventral bay.

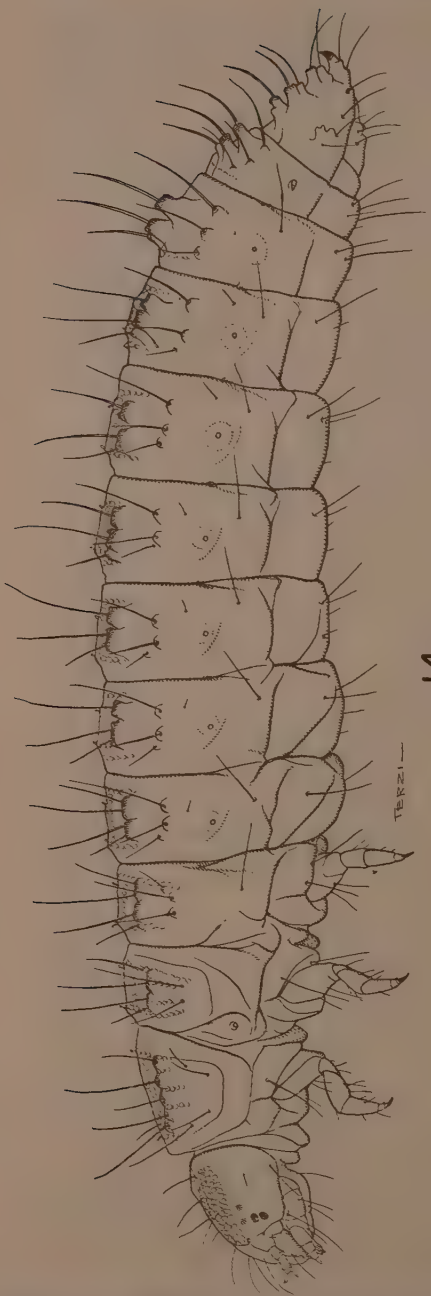
*Hypopharynx* (fig. 7) consists of a corneous bridge at the base of the mandibles and, attached to it ventrally, a membranous lingua, which lies dorsal to the prementum. The latter bears a number of minute hairs on its antero-lateral margins and flange-like superlinguae, one on either side. These are not shown in the figure. The anterior margin of the hypopharyngeal bridge bears two anterior horns which extend anteriorly and bear a tuft of outwardly-directed hairs on each. Between the two horns, there is an oval tuft of hairs. Posteriorly a pair of suspensory apodemes supports the hypopharynx.

The dorsal surface of each segment of the *body* is somewhat flattened and, except at the sides, generally devoid of major setae. There are, however, on the scutum of each, two marginal rows of minute modified setae, anteriorly and posteriorly. Small cuticular warts are scattered somewhat sparsely over the surface of the scutum and, in the abdominal segments especially, these are arranged chiefly on the anterior and posterior margins thereof. In the more dorsal of the two lateral rows, only two setiferous processes (referred to by Blair) are placed on the pronotum on either side, though there are two or three isolated major setae on slight tubercles arranged in line with them. The meso- and metanota each bear three lateral processes, the abdominal segments, up to the 8th, only two. Of the more ventral row, which also belongs to the respective terga, three setae are borne on tubercles on each segment up to the 8th abdominal.

*The modified setae* (figs. 13, b, c) borne on each segment, as well as on the disc of the head, are scale-like, expanded at the tip into as many as seven points. These points do not appear all to be in the same plane, but the seta itself rather to be hollowed out and to be bearing the points along its anterior margin. The anterior and posterior margins of the scutum of each thoracic segment bears a transverse row of six of these modified setae and there are also two similar rows of four modified setae on the abdominal segments up to the 8th, though some setae tend to resemble short rods rather than scales. The pronotum also bears one or two modified setae on each side.

On the *9th abdominal* segment a transverse row of cuticular warts extends across the tergum from the lateral processes to the anterior pair of backward-curving hooks, described by Blair. There are two setiferous processes on either side of the segment, more widely separated than in the other segments. The lower series of processes or tubercles, which also appertain to the tergite, consist of five in this segment, three in each of the others. The *pleura* are obscure, the sutures being ill-defined except in the thorax. The *sterna* of the first eight abdominal segments bear two transverse rows of setae each raised on slight tubercles, the anterior ones short and the posterior long and fine. The sternum of the 9th abdominal segment is situated at the anterior end of the segment, bordering on the *anal pseudopod*, from which it is separated by a fold, probably representing the 9th pleuron. It bears a transverse row of short setae. The 10th segment lies at the base of the pseudopod, postero-ventrally, the tergum forming a lobe posteriorly and the sternum the base of the pseudopod. The anal pseudopod bears two papillate lobes at the apex, side by side, and a row of fine, short setae at their base. The anus lies posterior to the two lobes at the apex of the pseudopod.

*Legs* of moderate length, placed somewhat wide apart. The coxae of each, but especi-

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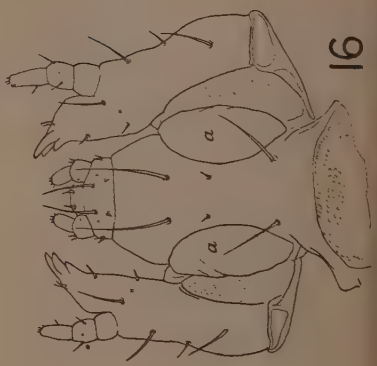


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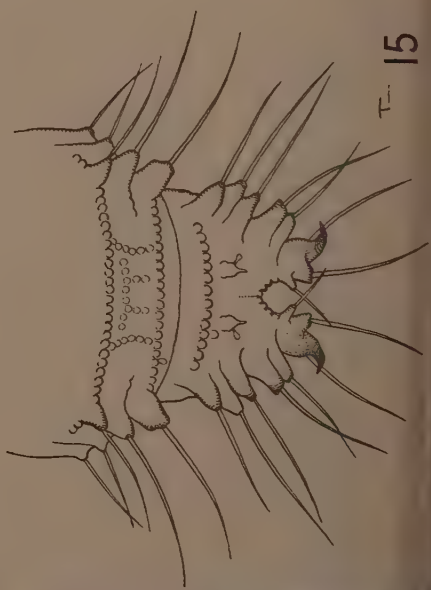

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FIGS. 14–17.—*Hapalips* sp. 14. Larva, side view, × 22. 15. 8th and 9th abdominal segments, dorsal aspect, × 32. 16. Inferior mouth-parts, × 85; *a*. articulating areas. 17. Maxillary mala, ventral surface, × 220.

ally those of the posterior pair, are long in proportion to the femora. The claw is rather long and tapered, and bears a single seta near its base. The *spiracles* (figs. 8, 9, 10), which are extremely small, are situated laterally in the tergum, in the mesothorax at about one-third of its length from the anterior margin, and in each of the first eight abdominal segments midway between anterior and posterior margins. Each is raised above the general surface on a distinct tubercle. The two chambers are short, proportionally shorter in the abdominal than in the thoracic spiracles, and bear a few strengthening annulae in each. The opening to the atrium is rounded except on the side where the chambers are attached. It does not extend to the full width of the atrium. I have been unable to find any closing apparatus.

This insect was named *Thallisellodes angulosus* by Arrow in his volume on Erotylidae in the *Fauna of British India* series. He has since stated (1929) that the generic name *Thallisellodes* must be sunk.

### *Hapalips* sp.

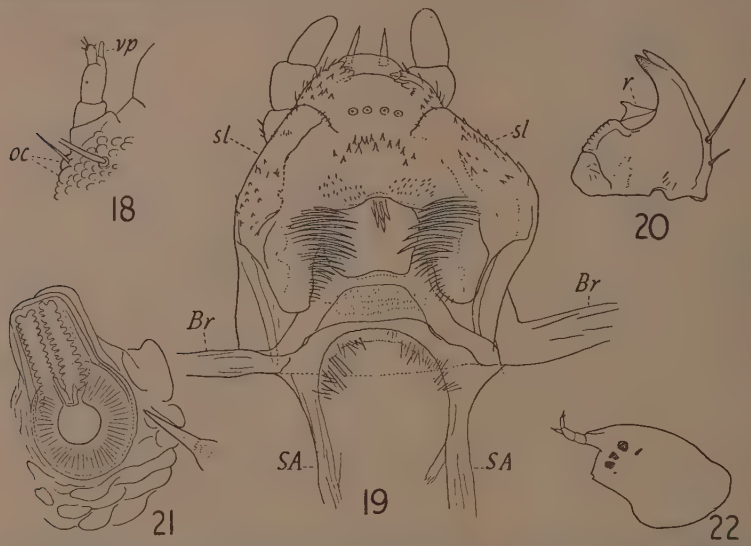
Five larvae received on loan from United States National Museum, per Dr. A. G. Böving. These are labelled "N.O. No. 8081, banana leaf, Mexico."

Length (in spirit) about 5·25–6·5 mm.; width of third abdominal segment in largest about 1·2 mm. Scarcely fusiform, but tapered slightly in front and behind, yellow. Dorsal surface bearing many small warts or granulations symmetrically arranged, and a few club-shaped micro-setae, but with major setae only on the sides. Dorsal to the pleural suture the tergites bear two longitudinal rows of tapered spinous setae (fig. 14), running the length of the body up to the 8th abdominal segment. The more dorsal of these setae are borne on tubercles, small anteriorly, but gradually increasing in size, until on the 9th abdominal segment they become spiniferous processes. The body is terminated by a pair of upturned pseudocerci (fig. 15). Anal pseudopod bilobed. *Head* exserted, rounded, a little broader than long and somewhat flattened above. Almost epignathous. Epicranial suture obsolete. Surface with a large number of cuticular warts in a symmetrical pattern. Setae rather long and with blunt apices at the sides but medially short and club-shaped. Of the latter a row of four are borne transversely near the posterior margin and two on the undifferentiated frons (fig. 24). Neck with two membranous folds, the more anterior partly concealing the gula. Occipital foramen nearly as wide as the head. *Labrum* semicircular, bearing eight setae on the dorsal surface and seven on either side of the anterior margin. *Clypeus* articulated with labrum, but fused at its base with epistome and frons, without any sign of epistomal suture. *Epipharynx* with V-shaped hairy process anteriorly and a row of oblique ridges on either side. *Ocelli* (fig. 22) generally five on each side, consisting of three large pigmented spots in a row dorso-ventrally, posterior to the antenna and two small spots posterior to the rest. *Antenna* (fig. 18) short, on a raised base, the length of its segments as 8 : 11 : 6. Accessory segment (fig. 18, *vp.*) as long as third segment, swollen at base, digitiform.

*Mandible* (fig. 20) sickle-shaped, with two long incurved teeth at the apex, pointed and placed close together. Mola distinct, bearing transverse ridges on its inner surface and five or six rows of scales transversely on the ventral surface. At its base the mandible bears a membranous lobe, having short hairs on its inner margin. Between the apical teeth and the mola on the inner side there is a translucent tooth or retinaculum, sharply pointed and slightly hooked. Ventrally the mandible bears a ridge-like process between the articulating condyle and mola, and this overlies the adductor muscle as in *Dacne*.

*Maxillary mala* (figs. 16, 17) angular on the outer margin and sharply bent inwards towards the pointed apex. The apex bears three brownish unci, projecting inwardly and pointed. On the anterior margin, near the base of the unci, there is a cluster of three short,

unequal setae. On the inner margin, a little posterior to the unci, a single stout tapered seta projects. Dorsally along the inner margin there is a row of rather stiff, finely tapered setae. *Stipes* somewhat narrow. *Cardo* at right angles to stipes, long and narrow. *Articulating area* (fig. 16, *a*) oval, extending to the concave lateral margin of the labium. *Labium* free for about half its length, to the base of the hypopharynx within. *Ligula* blunt and rounded. No transverse sutures are visible in the labium except that at the base of the prementum and there is no clear line of separation of it from the gula. A pair of somewhat long tapered setae is borne on the prementum near the base of the palps, in addition to two or three pairs of minor setae. The rest of the labium bears two pairs of long setae, one a little anterior to the point of flexure, the other near the base, together with a pair of minor setae between them. The sides of the labium in the region of these setae are concave,




FIGS. 18–22.—*Hapalips* sp. 18. Antenna, dorsal aspect, × 85; *oc.* ocelli, *vp.* accessory ventral process. 19. Hypopharynx, dorsal aspect, × 225; *Br.* lateral "bracons," *lg.* ligula, *SA.* suspensory apodemes, *sl.* superlinguae. 20. Mandible, dorsal aspect, × 85; *r.* retinaculum. 21. Thoracic spiracle, × 450. 22. Arrangement of ocelli, × 34.

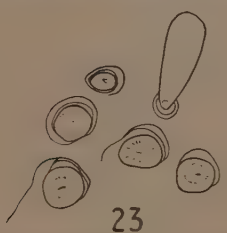
adjoining the articulating areas. The *gula* is expanded laterally at the base, where it is partly concealed by a fleshy protuberance of the neck, and contracted anteriorly where it joins the labium. *Ventral bay* wider than long, nearly rectangular. Hypostomal ridge not continued basally beyond the posterior angle on either side.

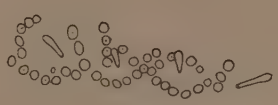
*Hypopharynx* (fig. 19) formed of a somewhat short, arched, transverse bar, bearing two short horns anteriorly, somewhat obscured from the dorsal surface by a longitudinal row of long and stout hairs or teeth on either side, arising from the membrane of the surface. More laterally a slightly hairy, flange-like superlingua arises from the transverse bar on each side and extends forwards to the level of the labial palps. A fleshy, minutely hairy *lingua* occupies the under surface of the prementum, posterior to the ligula, and is a part of the hypopharynx. At the sides the hypopharyngeal bridge is connected by ligament with the mandible on either side and at its base bears a pair of long and slender suspensory apodemes.

*Pronotum* the longest tergite of any segment. It is bordered on each side by a pallisade of long setae and is adorned with numerous cuticular warts, which also form the anterior

and posterior margins of the tergal plate. Besides the lateral setae, the scutum bears a pair of minute club-shaped (fig. 23) and a pair of longer rod-shaped setae near the anterior margin; a transverse row of four club-shaped microsetae, with two on either side more laterally, in the middle area; and a row of six similar microsetae near the posterior margin. The lateral macrosetae are placed on isolated tubercles, two on each side being larger and more corneous than the rest. *Meso-* and *metanotum* each with one row of six club-shaped microsetae anteriorly, another similar row posteriorly and with three raised setiferous processes on either side. Cuticular warts confined chiefly to the anterior and posterior margins, but also with two longitudinal lines of warts on either side of the median suture. 1*st to* 8*th abdominal terga* similar, but with only four club-shaped setae in each row, anteriorly and posteriorly, and with only two prominent setiferous processes on either side.

*Pleura* of thorax clearly defined and divided by the vertical suture into episternum and epimeron, the latter bearing a tapered seta. In the first eight abdominal segments the pleura are not clearly defined on their dorsal margins but are more clearly separated from




FIGS. 23–24.—*Hapalips* sp., modified setae. 23. Medio-lateral seta and cuticular warts on pronotum, × 350. 24. Row of setae at base of head, × 85.

the sterna by the pleuro-sternal suture. Each bears two principal setae, of which the posterior is the longer.

*Sterna* broader than long and in the abdominal segments narrower in front than behind. Thoracic sterna with one or two pairs of somewhat short setae; abdominal with two rows transversely arranged, the posterior row being the longer.

9*th abdominal* tergum (fig. 15) with a row of cuticular warts across the anterior margin, from which depend two short series of warts longitudinally, one on either side of the middle. On either side of the tergum there is a row of five digitate processes, each bearing a stout tapered seta. Posteriorly the two pseudocerci protrude, bearing at the apex of each a brown upturned hook and at the sides three setiferous tubercles. Between the pseudocerci there is a rounded space, margined with a single row of cuticular warts. Ventrally the remaining sclerites are enclosed within an arched furrow of membranous cuticle, the 9th abdominal pleurum. At the anterior end of this area is the 9th sternite, somewhat excavate behind and bearing a transverse row of setae. Posterior to the 9th sternite lies the 10*th sternite* which also bears a transverse row of setae and encloses the two anal papillae, side by side. Posterior to the anal papillae there is the anus, which with the anal papillae can be enclosed by a flap-like sclerite, the 10*th tergite*. This too bears a transverse row of setae.

*Legs* rather short, each pair placed rather widely apart. Coxa the longest segment, nearly oval in outline. Like the other segments, the coxa bears a few setae, these being longer than the rest of those on the leg. Claw arched and pointed, bearing a longer and a shorter seta at the base.

The *spiracles* (fig. 21) are borne in the anterior of the two lateral lobes of the mesothorax and near the middle, in the lateral part of the tergite, in each of the first eight abdominal segments. All are annular-bicameral, the aperture being round and moderately wide.

The atrium is nearly spherical and its walls are furnished with numerous unbranched trabeculae. The entrance to the trachea is round and is guarded by fine, closely-set trabeculae. Each of the two chambers is lined on either side by a row of spines. The closing apparatus is found at the end of the rather long spiracular trachea. It consists of a distinct lever, with muscle attached, and a slender bow encircling the end of the trachea. In one abnormal specimen the first abdominal spiracles were found to be annular and without chambers, but the remainder were normal and similar to, though smaller than, the thoracic spiracles.

The genus *Hapalips* has often been placed within the family Cryptophagidae, as by Grouvelle (1908) and Champion (1913), but was removed to the Languriidae by Arrow (1929). It had already been placed next to *Thallisella* by Gorham (1898). As will be seen, the characters of the larva are more nearly akin to those of both Languriinae and Cladoxeninae than to those of the Cryptophagidae. Of these two subfamilies, both considered by Arrow as belonging to the family Languriidae, the characters appear to bring the genus within the Cladoxeninae rather than the Languriinae.

The presence of the two papillae at the apex of the anal pseudopod separates this genus from most Cryptophaginae, the biarticulate labial palps, the completely-separated labrum and the five ocelli on either side from all. From the Languriinae it is separated by the large number of ocelli (5) on either side of the head, the progressive increase in size of the two longitudinal rows of tubercles along each side of the body and the presence of minute modified setae on the dorsum. On the other hand, the shape of the retinaculum and the arrangement of the 10th abdominal segment much resemble the corresponding characters found in the Languriinae.

The larval characters thus seem to bring the genus within the subfamily Cladoxeninae, though they also show a greater affinity to the Languriinae than do those of other members of the subfamily so far examined.

### Languriinae Arrow.

The name Languriinae is used here to denote the subfamily as separated by Arrow (1925) from Cladoxeninae. It excludes the Telmatophilini, which according to the observations of Böving and Craighead (1931) should be included in the family Cryptophagidae, though Arrow (1929) in his later paper suggested that this group should be included in the family Languriidae, on the ground that both have dilated pseudo-tetramerous tarsi in the adult. With some hesitation in face of this evidence, however, I deem it best, for the present, to follow Ganglbauer and refer the group to the Cryptophagidae.

The principal characters of the adult Languriinae are as follows :

Anterior coxal cavities open behind; terminal segment of maxillary palp bluntly pointed; first three tarsal segments with flat pads beneath, fourth segment rudimentary; inner lobe of maxilla with one to four teeth; antenna with club of from three to six segments, flattened and dilated more on one side than the other.

In the larvae of the subfamily, the epicranial suture is frequently obscure, but usually shows a short metopic branch at the base of the head; the clypeus is completely fused to the frons; ocelli less than five on either side; mandible with mola and single incisory margin, bearing retinaculum (except in *Teretilanguria*) broad at the base and sharply pointed at the apex, and with apical teeth two or three; maxillary mala falciform and bearing a row of setae along the inner margin; hypopharynx with anterior horns; dorsal setae normally-tapered; 10th abdominal segment arranged as a valve, which encloses the anal pseudopod on its withdrawal.

The LANGURIINAE are evidently nearly related to the CLADOXENINAE, *Hapalips* being apparently a transitional form between the two subfamilies. In the adults the abrupt 3-segmented symmetrical club to the antenna of the CLADOXENINAE seems to be the most important character separating them from the LANGURIINAE (Arrow, 1925). In the latter the club is not usually so distinct, its segments are frequently asymmetrical and their number varies from three to six. The larvae differ from those of the CLADOXENINAE by the presence of a short metopic or coronal branch at the base of the epicranial suture; by the fewness of the ocelli, these being sometimes entirely absent and so far as observed not exceeding two on either side; by the pointed retinaculum on the inner margin of the mandible, present in all species examined with the exception of *Teretilanguria*; and finally by the absence of the short modified setae and the lateral setiferous tubercles found on the larvae of CLADOXENINAE here described.

Perhaps some of these characters may be adaptations to a life spent within the stems of plants. Arrow (1925) contrasts the habit of the larvae of this subfamily, which usually feed within the stems of plants, with that of the EROTYLINAE and TRIPLACINAE, which feed on fungi. To this habit he attributes the elongate form of the Languriine larva—clearly an adaptational character, if, as is probable, the inference is correct.

Attention should be given to the valve-like structure of the tenth abdominal segment, whereby the anal tube may be withdrawn and enclosed within the dorsal and ventral sclerites (see figs. 37 and 44). In other subfamilies, except CLADOXENINAE, and in the CRYPTOPHAGINAE the sclerites of the 10th segment form the base of the tube, which can only be withdrawn within itself.

### *Languria bicolor* Fab.

Two larvae received from the United States National Museum per Dr. A. G. Böving, one from stem of *Mesadenia atriplicifolia*, Prospect Hill, near Great Falls, Va., August 1922, the other from Chittenden collection, Glen Echo, Maryland, 4th Sept., 1897.

Length (in spirit) about 16–17 mm., subcylindrical, yellow. The head on the dorsal surface and the body on both dorsal and ventral surfaces bear numerous short, very fine, setae. The 9th abdominal segment is terminated by a pair of sharp, upturned pseudocerci, at right angles to the body.

*Head* exserted, somewhat hypognathous, about equally long and broad. The epicranial suture obsolescent, developed posteriorly in the form of a Y.

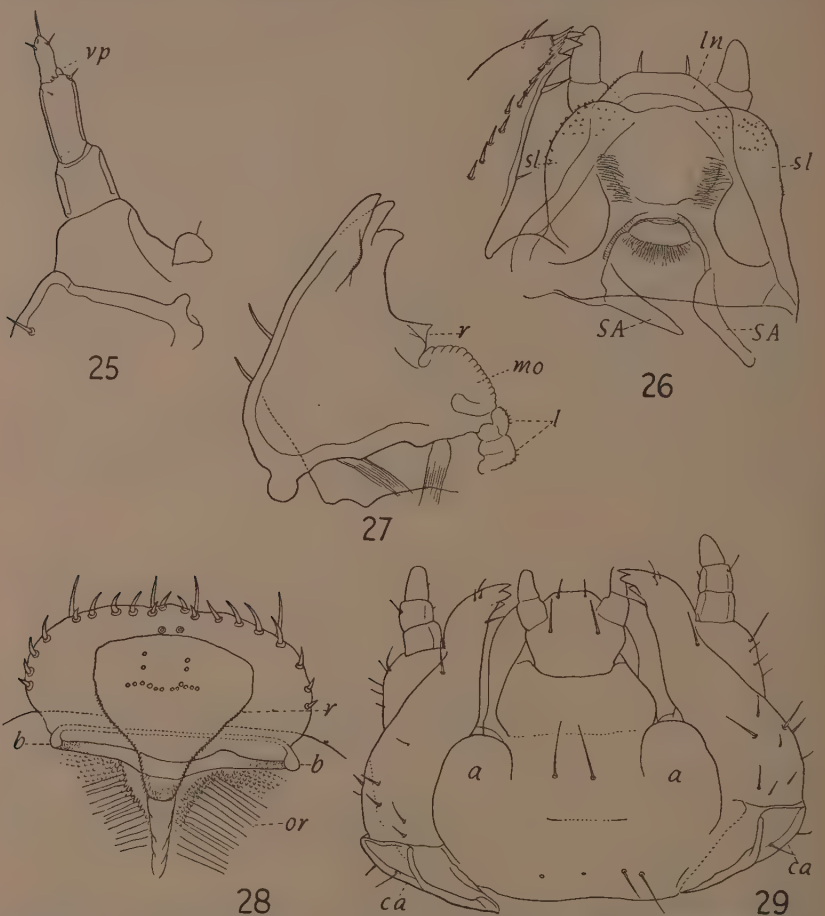
*Labrum* (fig. 28) short, transverse, with 9–10 setae of varying length on either side of the anterior margin and four longer ones on the dorsal surface.

*Clypeus* articulated with labrum, but completely fused with frons; narrowed anteriorly; without epistomal ridge at base.

*Epipharynx* (fig. 28) with V-shaped hairy process anteriorly and rows of oblique ridges on either side. *Ocelli* absent.

*Antenna* (fig. 25) short, the relative length of its segments as 18 : 25 : 14; accessory segment (*vp.*) at apex of second segment ventrally, minute, conical. *Mandible* (fig. 27) with three teeth at the apex, a prominent mola, marked with transverse striae, and between apex and mola a short pointed tooth or retinaculum. At the base of the mola there is a bilobed membranous process, bearing a few minute hairs. The inner margin of the mandible forms a single cutting edge. *Maxillary mala* (fig. 26) pointed, curved inwards and bearing three inwardly-directed unci at the apex. At the base of these near the anterior margin is a cluster of three setae on the ventral surface and on the inner margin a solitary

tapered seta. Dorsally a row of 12 to 14 setae extends from apex to base near the inner margin. *Stipes* (fig. 29) of moderate width. *Palps* triarticulate; when extended, reaching a little beyond the mala or the labial palps. *Cardo* (*ca*) at right angles to stipes; long, narrow, and pointed. Between cardo, stipes and labium lies an oval *articulating area* (*a*).




FIGS. 25–29.—*Languria bicolor*. 25. Antenna, ventral aspect, × 85; *vp*. ventral accessory process. 26. Hypopharynx and apex of maxillary mala, dorsal aspect, × 85; *ln*. lingua, *SA*. suspensory apodemes, *sl*. superlinguae. 27. Mandible, ventral surface, × 85; l. bilobed process, *mo*. mola, *r*. retinaculum. 28. Epipharynx, × 85; *b*. base of labrum, *or*. oblique ridges, *v*. V-shaped ridge. 29. Inferior mouth-parts, × 50; *a*. articulating areas, *ca*. cardines.

*Labium* free for about half its length. Prementum nearly circular, bearing biarticulate palps. Ligula not produced. Mentum and submentum not clearly demarcated, the former bearing a pair of setae and the latter two pairs, in each case near the base. The *ventral bay* is rather long and wide, with the posterior angles somewhat rounded and a stout hypostomal ridge at either side continued towards the base of the head for a considerable

distance beyond the cardo. *Hypopharynx* (fig. 26) with skeletal parts well developed. The main transverse bar is arched anteriorly and bears on either side a horn or arm directed forward and densely clothed with fine hairs. Posterior to the transverse bar is an oval space, bounded on its posterior side by a narrow bar, densely covered with very fine, short hairs. Ventrally the hypopharynx supports a fleshy lingua, overlying the prementum. On either side of the lingua, a narrow lobe, sparsely clothed with short spines, lies adjacent and fused to it. These two lobes represent the superlinguae. On either side the hypopharynx is supported by a lateral ligament, connecting it with the base of the mandible, and at the base by two substantial suspensory apodemes (*SA*).

*Body*. *Pronotum* only a little longer than the other tergites, a little paler in colour on the anterior and posterior margins. Its texture is smooth and it bears, like the other tergites, a large number of fine short setae, irregularly disposed and of varying length. These setae are progessively more numerous on the posterior segments. *Thoracic pleura* divided transversely by a rather deep suture into episternum and epimeron. *Abdominal pleura* almost continuous with the terga, divided from the sterna by a faintly discernible pleural suture. Each, up to the 8th abdominal pleuron, bears in the anterior half a rounded, raised area, on which are some ten short setae. *Abdominal sterna* rectangular, broader than long. The *9th abdominal* tergite is smooth. Posteriorly it bears a pair of upturned, sharply pointed pseudocerci, each brown at the tip and bearing a moderate number of longer and shorter setae around the basal part. *10th abdominal segment* postero-ventral. The tergite forms a small plate beneath the pseudocerci, the sternite, when distended, a conical process bearing at its apex a pair of sucker-like lobes, side by side, being the pseudopod. The tergite bears a transverse row of setae, the sternite a larger number of somewhat shorter setae round the base of the pseudopod.

*Legs* rather short, the coxa of each moderately long compared with other segments and coming to a blunt point inwardly at the apex. Claw rather short, curved, bearing two short setae at the base. The *spiracles* are situated laterally in the anterior part of their respective segments, namely, in the membranous part of the mesonotum and in the anterior third of each of the first eight abdominal tergites. The thoracic spiracles are broadly oval and considerably the largest. Each bears two minute chambers, toothed round their margins, directed postero-dorsally and raised above the rim of the spiracle. Within the spiracle, the atrium is densely felted at the sides with fine, short trabeculae. The abdominal spiracles are round and smaller, but similar in structure to those of the thorax. A valvular closing apparatus is present at the end of the short spiracular trachea.

## *Caenolanguria nilgirensis* Gorh.

Eight larvae received from Mr. J. C. M. Gardner, taken by him from stems of herbaceous plants in the Anamalai Hills, Madras, May 1930. He has already given (1931) a good short description of the larva.

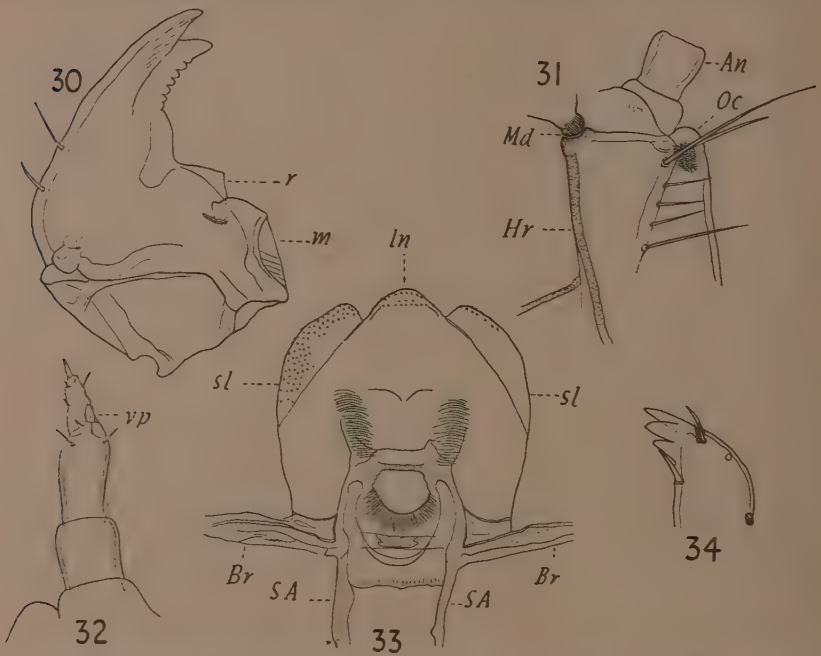
Length (in spirit) of largest about 16 mm., breadth about 1·5 mm. Nearly cylindrical, creamy white. Setae short, yellow and very fine, causing the larva to appear almost naked. A pair of short, pointed pseudocerci is situated at the end of the 9th abdominal segment, upturned at right angles to the body.

*Head* exserted, inclined at an angle of about 45° to the horizontal, slightly broader than long; cuticle smooth, bearing numerous fine yellowish setae, mostly short. Epicranial suture nearly obsolete, but with a faint and short coronal branch at the base. *Labrum* transverse, rounded anteriorly and at the sides, bearing 10–12 short stiff setae along the anterior margin on either side.

*Clypeus* fused to frons, narrowed anteriorly, without epistomal ridge at base. Epipharynx with V-shaped scaly process anteriorly and oblique ridges in rows on either side. One *ocellus* (fig. 31, *oc.*) is present on each side, postero-ventral to the antenna.

*Antenna* (fig. 32) short, the relative length of its segments as 19 : 26 : 17; accessory process at end of second segment, ventrally, short and digitate. Third segment bearing a rather stout, tapered seta at the apex.

*Mandible* (fig. 30) with two incurved teeth at the apex, the more dorsal one having its inner margin serrated. At the base is a stout mola, somewhat flattened on its inner surface and bearing a few rather faint striae. A triangular retinaculum (*r*). is situated between the mola and the apical teeth. No membranous lobe has been found at the base. *Maxillary mala* pointed and bearing three stout inwardly-directed unci at the apex. At




FIGS. 30–34.—*Caenolanguria nilgirensis*. All figures × 85 cir. 30. Mandible, ventral surface; *m*. mola, *r*. retinaculum. 31. Hypostomal and antennal areas; *an*. antenna, *hr*. hypostomal ridge, *md*. ventral articulation of mandible, *oc*. ventral ocellus. 32. Antenna, ventral aspect; *vp*. ventral accessory process. 33. Hypopharynx; *Br*. lateral "bracons," *ln*. lingua, *SA*. suspensory apodemes, *sl*. superlinguae. 34. Apex of maxillary mala, ventral surface.

the base of these near the outer margin is a cluster of three setae and on the inner margin a single stout seta. On the dorsal surface, near the inner margin, there is a row, and for about half the distance a double row, of sharply pointed setae, reaching from base to apex. *Stipes* of moderate width. *Palps* triarticulate reaching beyond the labial palps and mala. *Cardo* at right angles to stipes, long and narrowed to the apex. An oval *articulating area* lies between maxilla and labium.

*Labium* free for half its length or a little more. Prementum clearly defined, round and bearing biarticulate palps. Ligula not produced. No division between mentum and submentum is visible, but a pair of major setae in the middle of this area and another pair at its base probably represent the bases of mentum and submentum respectively. *Ventral bay* (fig. 31) nearly rectangular, about twice as broad as long; the stout hypostomal ridge

continued for a considerable distance beyond the angle. *Hypopharynx* (fig. 33) much like that of *Languria bicolor*, but the main bridge, though arched to the anterior horns, is more corneous at the base dorsally, thus forming a complete transverse bar, continuous with two bracons or lateral ligaments. The space behind the anterior margin of the bridge is nearly circular. On either side of the lingua there is a narrow superlingua clothed with minute hairs, as in *Languria bicolor*.

*Prothorax* longer than the other thoracic segments, about equal to the longest of the abdominal segments, such as the seventh.

*Thoracic pleura* distinct, divided transversely into episternum and epimeron, but the abdominal pleura are fused with tergum and sternum of their respective segments. Abdominal *sterna* bear each a transverse row of four fine, short, setae posteriorly and a few still shorter setae anterior to these.

*9th abdominal segment* is smooth dorsally but bears a transverse row of four fine yellowish setae, as well as some shorter ones at the base of the pseudocerci. The pseudocerci are placed terminally, close together and at right angles to the plane of the body. Their apices are sharply pointed and infuscated. Laterally there is a row of fine setae a little above the suture separating the 9th and 10th segments.

The *10th abdominal segment* is situated postero-ventrally. Its dorsal and ventral sclerites enclose the extrusible anal pseudopod. This is composed of two papilla-like lobes, side by side, and is surrounded by a considerable number of fine setae.

*Legs* somewhat short and wide apart. Coxa longer than any other segment. Claw fuscous, curved and rather long, bearing two short setae at its base. Other segments bear a number of fine, bristly setae.

*Spiracles* annular-bicameral, placed laterally in the anterior third of the mesothorax and of the first eight abdominal segments. Their chambers are directed postero-dorsally and are open at the apex. Each bears 9–10 short, blunt, teeth on either side. The atrium bears a few short fine hairs on its walls and at the bottom has an opening into the trachea, oval in the thoracic spiracles, and almost closed by long, straight trabeculae. A valvular closing apparatus is present at the end of the short spiracular trachea.

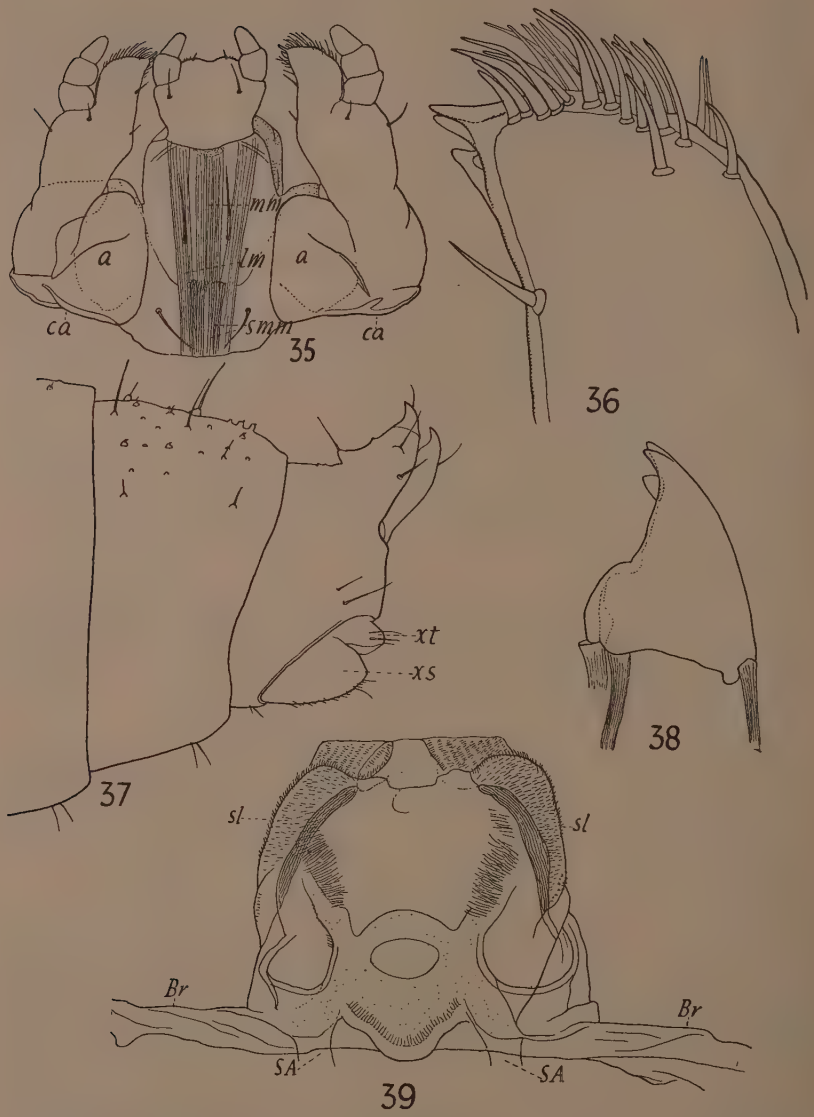
*Note.* A specimen of *C. birmanica* Har., taken from *Girardenia heterophylla* at Dehra Dun, U.P., India, was also kindly given me by Mr. J. C. M. Gardner. Its general characters are similar to those of *C. nilgirensis*, but it is somewhat more slender and appears entirely to lack ocelli. The serrations on the apical tooth of the mandible are less distinct and the retinaculum is slightly longer in *C. birmanica*.

### *Teretilanguria metallica* Gorh.

Larvae, near maturity and younger, from the stems of *Urera baccifera*, taken by Herr F. Nevermann at Hamburg Farm, Costa Rica. Some of these were kindly lent by the authorities of the Staatliche Museum, Dresden, through the good offices of Dr. F. van Emden. The remainder, together with pupae and an adult beetle, were lent by Dr. van Emden from his private collection.

Length of largest about 26 mm., width 5mm., at 4th abdominal segment, after preservation in alcohol. Subcylindrical and bearing a pair of upturned pseudocerci posteriorly; cuticle horny and yellowish-brown above, paler laterally in the region of the spiracles and ventrally.

*Head* (fig. 40) exserted, slightly broader than long, rounded at the sides. The dorsal surface is somewhat flattened in the frontal region. Epicranial suture distinct, Y-shaped, the frontal branches together delimiting a lyre-shaped frons. *Ocelli* one on either side near the base of the antenna ventrally and sometimes a second and smaller one. *Antenna* three-segmented on a distinct basal process; second segment about twice the length of the




FIGS. 35–39.—*Teretilanguria metallica*. 35. Inferior mouth-parts, showing labial muscles, × 34; *a*. articulating areas, *ca*. cardines, *lm*. lateral muscles of the prementum, *mm*. median muscles of the prementum, *smm*. submento-mental muscles. 36. Apex of maxillary mala, × 220. 37. Posterior segments of larva, lateral aspect, × 25; *xt*., *xs*. tergite and sternite of tenth abdominal segment. 38. Mandible, ventral surface, × 34. 39. Hypopharynx, dorsal surface, × 85; *Br*. lateral "bracons," *SA*. suspensory apodemes, *sl*. superlinguae.

first; third segment narrow, digitiform, rather less than the first in length; accessory segment short, papilla-like.

*Clypeus* fused with frons. *Labrum* articulated to anterior margin of clypeus, bearing about 9 setae of various sizes on either side dorsally and some 12–14 on either side of the anterior margin.

*Epipharynx* bearing a V-shaped hairy ridge anteriorly and numerous closely-set, oblique ridges on either side.

*Mandible* (fig. 38), triangular, with two pointed teeth at the apex and a third on the inner margin immediately posterior to them. The incisory margin is plain, without process or retinaculum. Mola well developed, but without striae. *Maxilla* (fig. 35) markedly elbowed, the cardo narrow and reduced to a point at its articulation with the hypostomal ridge. The mala (fig. 36) is hardly falciform, its anterior margin rounded and thickly

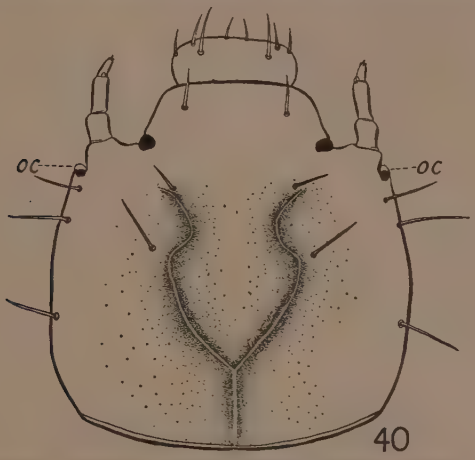



FIG. 40.—*Teretilanguria metallica.* Head, dorsal surface, showing epicranial suture, × 25; *oc.* ocelli.

clothed with inward-curving setae. At the anterior end of the inner margin three pointed unci project inwardly and, more posteriorly, a single stout seta, placed on the margin. Dorsally there is a row of some twelve to fourteen setae near the inner margin also projecting inwards. Palps, cardo much like those of *Languria*. *Articulating area* (fig. 35, *a*) between maxilla and labium broadly oval in the older larvae, obliquely divided into two and bearing a few minute setae round the margin. *Labium* divided by transverse sutures into three parts, free for the anterior half or more of its length. Prementum nearly heart-shaped, broader in front than behind and having a slight median emargination anteriorly. Mentum bearing a pair of stout setae extending posteriorly a little beyond its connection with the articulating areas. The suture at the base is sometimes indistinct. The submentum is somewhat broader than long and adjoins the gula between the two crescentic posterior tentorial pits. *Gula* short and transverse.

The main transverse bar of the *hypopharynx* is X-shaped (fig. 39). Anterior horns arise, clothed with fine hairs, one on either side of the middle. The hollow space posterior to these is oval and is bounded by the basal structure which projects in a rounded process between the bases of the suspensory apodemes. On either side a rounded hollow structure proceeds ventrally and forms the connecting support for the flange-like superlingua and the membranous lingua on the dorsal side of the prementum. The lateral ligaments (*Br*) on either side form with the base of the hypopharynx a continuous ventral plate at the base.

The *ventral bay* for the reception of the inferior mouth-parts is rectangular and nearly twice as broad as long. The hypostomal ridge is continued beyond its posterior angle for only a short distance towards the base of the head.

The *dorsal scuta* are brown, surrounded by a pale marginal area, the dark scuta reaching to the pleura in the thorax, but leaving in the other segments, a wide paratergal area, in which the spiracles are situated. Apart from the last two or three segments the tergites are almost smooth (though the cuticle is minutely rugose) and bear two transverse rows of minute yellowish setae, sparsely distributed. The *pleura* of the thoracic segments are clearly defined and divided into episternum and epimeron by the vertical pleural suture. In the abdominal segments the pleuro-sternal suture is distinct, but the pleuro-tergal suture is only faintly visible beneath the row of spiracles. Each abdominal pleuron bears three short tapered setae. The abdominal *sterna* are rectangular and bear a single row of short, slender setae near the base of each.

The *9th abdominal segment* (fig. 37) bears two stout terminal pseudocerci, turned upwards, each having two slightly recurved hooks at its apex, in addition to a number of pointed chitinous spines on other parts of the process. At the base of the pseudocerci there are also other short stout chitinous spines. A larger number of similar spines, some of them bearing tapered yellowish setae, is also found on the 8th tergite and, in decreasing number and size, on the 7th and even on the 6th tergite. The 9th sternite is anterior to the 10th segment and is divided somewhat obscurely from the tergite.

The *10th abdominal segment* is postero-ventral to the 9th tergite and when retracted appears as two unequal arcs of a circle, bounded by a circular groove. The larger and anterior sclerite (*xs*) represents the sternite, the smaller and posterior sclerite (*xt*) the tergite. Between the two sclerites there is a transverse slit, through which the pseudopod can doubtless be extruded, as in other Languriine larvae. The sternite bears a large number of short sharp spinules, reminiscent of the *raster* of Scarabaeid larvae, the tergite a group of longer setae on either side.

*Legs* of only moderate length, the first pair near together, the other two pairs successively wider apart. Coxa long, slightly tapered and produced at the inner margin of the distal extremity into a rounded process. Trochanter as long or longer than coxa on inner side. Claw robust and short, with one short seta near the base.

*Spiracles* rather large and conspicuous, the opening being surrounded by a brown rim in the midst of the pale lateral area already mentioned. The thoracic spiracles are oval and bear two small accessory chambers on the postero-dorsal margin of each. The aperture to the atrium is widely open, surrounded by a narrow membranous rim. The trabeculae are short, except those guarding the oval entrance to the trachea. These are long, overlapping one another across the wide opening. Each chamber has numerous spinules on either side and has its surface closed by membrane save for a narrow linear slit, which extends for the length of the chamber to the atrial aperture. A valvular closing-apparatus is present, close to the lower end of the atrium, controlled by two sets of muscles. The abdominal spiracles are round and decrease progressively in size from the first to the eighth segment. Their accessory chambers are directed dorsally.

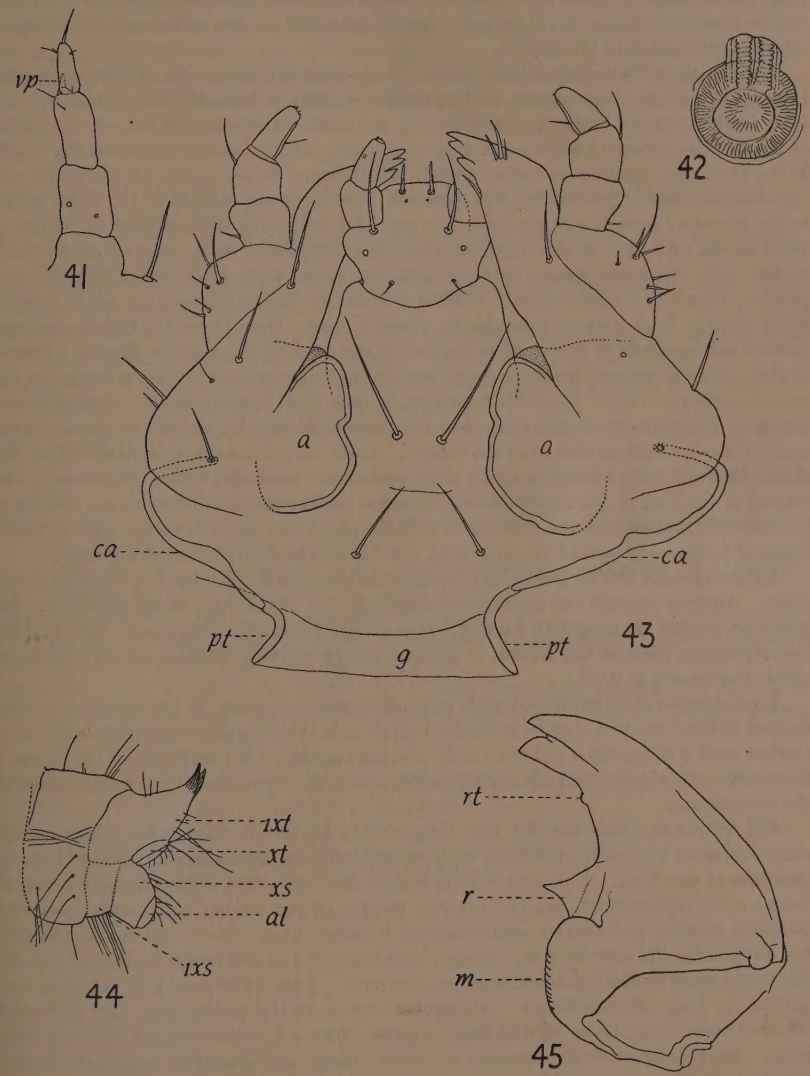
## *Dasydactylus cnici* Schwarz.

One larva received from United States National Museum, per Dr. A. G. Böving. Taken from *Amaranthus retroflexus* at Brownsville, Texas (McMillan Coll.), 5th January, 1909.

Length (in spirit) about 13 mm., breadth 1mm., yellow, subcylindrical. The larva bears a moderate number of tapered setae of no great length above and beneath. The cuticle is almost smooth, but not glabrous. The 9th abdominal segment is terminated by a

pair of upturned pseudocerci, sharply pointed and placed close together. A pale mediodorsal line extends from the mesothorax to the 8th abdominal segment.

*Head* exserted, broader than long, nearly parallel-sided. It bears rather numerous




FIGS. 41–45.—*Dasydactylus cnici*. 41. Antenna, dorsal surface, × 85; *vp*. ventral accessory process. 42. Spiracle of first abdominal segment, × 350. 43. Inferior mouthparts, × 85; *a*. articulating areas, *ca*. cardines, *g*. gula, *pt*. posterior tentorial pits. 44. Posterior segments of larva, lateral aspect, × 25; *al*. anal lobe, *ixs*. ninth abdominal sternite, *ixt*. ninth abdominal tergite, *xs*. tenth abdominal sternite, *xt*. tenth abdominal tergite. 45. Mandible, ventral surface, × 85; *m*. mola, *r*. retinaculum, *rt*. rudimentary tooth?

fine yellow setae, especially anteriorly on the dorsal surface. Epicranial suture obsolescent, though a short coronal branch is visible posteriorly. *Labrum* short, rounded at the sides and on the anterior margin, on which about 12 incurved setae are borne ventrally and four dorsally on either side. *Clypeus* completely fused with frons-epistoma, without visible epistomal ridge. Its sides only slightly narrowed to the bowed anterior margin, which is articulated to the labrum.

*Epipharynx* with V-shaped hairy ridge and at either side a number of oblique parallel ridges. One *ocellus* only clearly visible, postero-ventral to the antenna, with a trace of some further pigment beside it. *Antenna* (fig. 41) short, its segments of the relative length of 20 : 22 : 15; accessory segment at apex of second ventrally, nearly one-third the length of the third and standing on a short papilla, digitiform. *Mandible* (fig. 45) with only two apical teeth, curved inward and not serrated. On the inner margin of the more dorsal tooth, however, there is a slight knob (*rt.*), probably indicating the tendency to produce a third tooth. At base of the mandible there is a prominent mola, marked on its inner surface with transverse striae; between mola and apical teeth a somewhat long, sharply pointed, translucent retinaculum. *Maxillary mala* (fig. 43) angular on the outer margin, being sharply bent inwards towards the pointed apex. Here there are three stout and pointed yellow spines or unci. Near the base of the unci, on the anterior margin, a cluster of three setae of unequal length is found and on the inner margin, a little posterior to the unci, a single stout seta. Dorsally from apex to base there is a row of setae near the inner margin. These are stout anteriorly but are slender posteriorly, where two further setae are produced, a little farther from the margin. *Cardo* set at an angle of less than 90° to the stipes, long and with a stout marginal ridge posteriorly, concealed before dissection by the folding of the base of the mouth-parts. Between labium and maxilla on either side there is a sub-oval *articulating area*, connected with the cardo and stipes of the maxilla by membrane at its base and part of the outer side, but free and bluntly pointed at the apex.

*Labium* free for half its length and divided into three parts, each bearing a pair of major setae. Anterior margin of prementum straight, the ligula not being produced. Its posterior margin is somewhat pointed but scarcely V-shaped. The suture between the two remaining parts of the labium is situated nearly midway between the two posterior pairs of setae and is faint.

*Hypopharynx* well developed and generally similar to that of *Caenolanguria*. The median hollow, which in *Languria bicolor* is oval, is in these species round, but is similarly clothed with a dense mass of hairs on its posterior margin. On each side of the lingua a flange-like superlingua extends forwards from near the hypopharyngeal bridge beneath the prementum.

*The ventral bay* wide but not very long, as 74 : 31, almost rectangular. Hypostoma ridge continued beyond the posterior angle on either side for a considerable distance towards the base of the head. *Prothorax* a little longer than the other segments, with a row of longer setae transversely near the anterior margin of the tergum and another near the posterior margin, with shorter setae scattered between them. *Meso-* and *metanotum* similar, but lacking the anterior row. *Pleura*, both thoracic and abdominal, concealed beneath the tergal scuta in this specimen, semi-membranous. Abdominal *terga* 1–8, except in size, similar to that of metathorax. Abdominal *sterna* nearly rectangular, but somewhat widened posteriorly; 1st to 7th with four transverse rows of fine setae, the 8th with only three rows. *9th abdominal* tergite smooth, somewhat short and gradually contracted behind almost to a point, from which the two long, upturned pseudocerci arise. These are each smooth, sharply pointed and darkened at the apex. Fine setae of varying length are thinly scattered over the dorsal surface but are more numerous posteriorly, adjoining the 10th tergite. 9th sternite anterior to the 10th, bearing two transverse rows of setae in close proximity, the posterior row long. *10th segment* valvular, similar to that of *Languria* and with two anal lobes, side by side, at the apex of the pseudopod.

*Legs* of moderate length, rather spinous. Coxa long and bearing three spines, set on short papillae, on its anterior surface. Femur shorter and not greatly longer than trochanter. Tibia curved. Claw sharply pointed, curved, and of moderate length. *Spiracles* (fig. 42) annular-bicameral, widely open. Each chamber bears a number of annulations, with a row of minute spinous processes projecting inwards on either side. The trabeculae within the atrium are short and less numerous than in *Languria*, except those protecting the entrance to the trachae, which are long and unbranched. Entrance to trachea oval in thoracic, circular in abdominal spiracles. Position of spiracles as in *Languria*.

## References.


Anderson, W. H., 1936, A comparative study of the labium of coleopterous larvae. *Smithson. misc. Coll.* **95** (13).

Arrow, G. J., 1925, *Fauna of British India*; Coleoptera. Erotylidae, Languriidae and Endomychidae.

——, 1929, On the families of Coleoptera related to the Erotylidae. *Ann. Mag. nat. Hist.* (10) **4** : 305–322.

Böving, A. G., and Craighead, F. C., 1931, An illustrated synopsis of the principal larval forms of the order Coleoptera. *Ent. Amer.* (n.s.), **11** : 1–351.

Blair, K. G., 1929, Fauna of the Batu Caves, Selangor. *J.F.M.S. Mus.* **14** : 387.

Champion, G. C., 1913, *Ann. Soc. ent. Fr.* **77** : 58.

Chittenden, F. H., 1911, List of Insects affecting stored cereals. *Bull. Bur. Ent., U.S. Dept. Agr.* **96** : 8–13.

van Emden, F., 1928, Die Larve von *Phalacrus grossus* Er. und Bemerkungen zum Larven-system der Clavicornia. *Ent. Blätt.* **24** : 8–20.

Falcoz, L., 1922, Etudes sur les Cryptophaginae. II. *Henoticus californicus*. *Ann. Soc. linn. Lyon*, **69** : 167–183.

——, 1924, *id. IV*. Essai sur les Larves de *Cryptophagus*. *Loc. cit.* **71** : 120–127.

Ganglbauer, L., 1899, *Die Käfer von Mitteleuropa*, **3**.

Gardner, J. C. M., 1931, *Ind. For. Rec.* **16** (4) : 16–17.

Gorham, H. S., 1898, *Biologia Centrali-Americana*. (Coleoptera) **7** : 250 (*Hapalips*).

Grouvelle, A., 1908, *Ann. Soc. ent. Fr.* **77** : 58.

Lewis, G., 1884, Japanese Languriidae. *J. linn. Soc. Lond.* (*Zool.*), **17** : 347–361.

Newton, H. C. F., 1936, On *Atomaria linearis* Steph. and its larval stages. *Ann. appl. Biol.* **19** : 87–97.

Perris, E., 1877, *Larves des Coléoptères*.

Schenkling, S., 1928, *Coleopterorum Catalogus*, **100**, Languriidae.

Snodgrass, R. E., 1935, *Principles of Insect Morphology*.

Verhoeff, K. W., 1923, Beiträge zur Kenntnis der Coleopteren-Larven mit besonderer Berucksichtigung der Clavicornia. *Arch. Naturg.* **89** (A) : 1–109.

Zacker, F., 1926, *Mitt. Ges. Vorratsschutz.* **2** : 45–47.